UNITED STATES PATENT APPLICATION

FOR

HANDHELD COMPUTER HAVING MOVEABLE SEGMENTS THAT ARE
INTERACTIVE WITH AN INTEGRATED DISPLAY

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HANDHELD COMPUTER HAVING MOVEABLE SEGMENTS THAT ARE INTERACTIVE WITH AN INTEGRATED DISPLAY

5   RELATED US APPLICATIONS

This patent application is a continuation-in-part of, and claims priority to, U.S. Patent application No. 09/932,213, "Handheld Computer Having Moveable Segments That Can Be Adjusted to Affect a Size of the Handheld Computer",

10   filed August 17,2001.

FIELD OF THE INVENTION

The present invention relates to handheld computers. In

15   particular, the present invention relates to a handheld computer comprised of a moveable assembly that is adjustable to affect a size of the handheld computer.

BACKGROUND ART

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Handheld computers, typically referred to as personal digital assistants (PDAS), are intended to be mobile devices. In general, small sizes are desired for handheld computers to enhance mobility. However, there are constraints to how small

a handheld computer can be for convenience of the user. In particular, certain characteristics of handheld computers require a minimum amount of space on the exterior housing of the handheld computer.

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Most handheld computers require a minimum size display. The minimum display size is set by balancing considerations such as mobility with the need for the user to view data, such as personal management information, pictures, and text

10 pages. For some handheld computers, the size of the display may also need to be large enough to provide a character input mechanism for the user. For example, some handheld computers incorporate character recognition logic as a primary means for the user to enter character data into the handheld

15 computer. The displays for the handheld computer may be made to be contact-sensitive. A portion of the display may be combined with logic to provide an immediate character recognizer for recognizing gestures or strokes entered onto a portion of the display as characters. Other displays may be

20 used to display a virtual keyboard. The immediate character recognition regions and virtual keyboards require the displays to be of a minimum size to support those kinds of character entry.

The size of the handheld computer typically must also accommodate mechanical actuators, such as buttons or pivot switches. These are typically placed on the same surface where the display is viewable to enable users to coordinate

5 button actions with what is shown on the display.

As battery and printed circuit board technology becomes more advanced, the display size and mechanical actuators are increasingly becoming the primary factors that determine the

10 size of the handheld computer. Reducing the length of the handheld computer requires sacrificing features of the display and/or buttons.

The functional integration of handheld devices has led to

15 handheld computing devices that also function as wireless telephones. Conventional fixed placements of speaker and microphone in these integrated devices yield larger form factors that result in undesirable telephony experiences and do not provide for protection of the integrated display.

20

In fixed form factor devices the display is left exposed and unprotected from debris and facial oils during phone usage. Products that do provide protection with covers and

such have the disadvantage of not allowing the user access to

the hard phone and/or application buttons if they reside on

the cover. This is due to the cover having to be folded or

flipped away to provide access to the display during PDA use.

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SUMMARY OF INVENTION

Embodiments of the invention provide for a handheld computer comprising a first segment moveably coupled to a second segment. The second segment can be positioned to overlay a portion of the first segment so as to reduce a length of the handheld computer. The handheld computer can be manipulated into a contracted position so that the second segment is overlaid over a portion of the display on the first segment. A position sensor detects the relative position of the first and second segments to provide feedback to the display.

In an embodiment, the display includes floating text, images, or icons or that may repositioned in response to changes in position of the second segment so that they remain visible. Icons that are associated with keys located at the edge of the second segment may be kept in proximity to the keys so as to enhance the association between the icons and the keys.

In another embodiment, the edge of the second segment that borders the display is used to underline a character

string on the display. The character string may be one of a plurality of character strings displayed as a static list. Upon selecting or underlining a character string, a key or other actuator may be used to cause an instruction set

5   associated with the character string to be executed. A character string that has an associated instruction set is generally a macro command with the instructions and character strings being freely selected.

10   A special type of macro command is an address command. Character strings such as names of an entity and/or their addresses (e.g., email addresses, IP addresses, or telephone numbers) may be displayed as an address command. Line selection of an address command initiates a communications

15   application using the associated address (e.g., an email or telephone call.)

In yet another embodiment of the invention, a handheld computer provides integrated telephone functionality. The

20   integrated device has two distinct elements that reconfigure relative to each other through a sliding mechanism. The lower element houses the numerical dialer keys and microphone for telephone functionality in addition to the

navigation/application keys. The upper element houses the display/PCB/battery/speaker, etc.

The lower housing slides over a majority of the display

5   module in the closed position. Advantages to this

articulation are:

decreased overall length of the product for compact

storage and/or one handed telephony usage;

protection of the display from debris and sharp objects

10   during storage;

protection of the display from facial oils and chemicals

during telephony modes when device is placed against face and

ear;

provides a more ergonomically located 5 way center

15   navigation and numerical buttons for data retrieval and

telephone dialing;

partially exposed display is convenient for minimal PDA

and/or telephony information display. Recess provides a

degree of display protection.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention are illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings. Like reference numerals are intended to refer to similar elements among different figures.

FIG. 1 is a frontal view of a handheld computer having moveable segments configured in an extended position.

FIG. 2 is a frontal view of the handheld computer, with the moveable segments configured in a contracted position.

FIG. 3 is a back view of the handheld computer, with the moveable segments configured in an extended position.

FIG. 4 is a back view of the handheld computer, with the moveable segments configured in a contracted position.

FIG. 5 is a side view of the handheld computer, with the moveable segments configured in an extended position.

FIG. 6 is a cross-sectional view of FIG. 5, cut along lines A-A

FIG. 7 is a side view of the handheld computer, with the

5   moveable segments configured in a contracted position.

FIG. 8 is an exploded isometric view of a first moveable segment of the handheld computer.

10   FIG. 9 is an isometric view of a second moveable segment of the handheld computer.

FIG. 10 is a side view of a handheld computer formed by a first segment slideable connected to a second segment, the

15   two segments being positioned in an extended position.

FIG. 11 is a side view of a handheld computer formed by a first segment slideable connected to a second segment, the two segments being positioned in a contracted position.

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FIG. 12 is a partial; side cross-sectional view of the handheld computer formed by a first segment slideable coupled to a second segment.

FIG.13 is a back isometric view of a handheld computer, showing a first set of connecting mechanisms for moveably connecting two segments of a handheld computer.

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FIG.14 is a front isometric view of handheld computer; showing a second set of connecting mechanisms for moveably connecting two segments of a handheld computer.

10 FIG.15 is a cross-sectional view taken along lines A-A of FIG.13.

FIG.16 is a cross-sectional view taken along lines B-B of FIG.13.

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FIG.17 illustrates a hardware diagram for a handheld computer coupleable to one or more accessory devices.

FIG. 18 shows a handheld computer in a fully extended

20 configuration with a floating display of a visual object.

FIG. 19 shows the handheld computer of FIG. 18 in a partially closed configuration with a rearranged display of the visual object.

5   FIG. 20 shows a handheld computer with a display of a list of macro commands.

FIG. 21 shows the handheld computer of FIG. 20 with a macro command selected from the displayed list.

10   FIG. 22 shows the handheld computer of FIG. 18 integrated with a wireless telephone.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the invention describe a handheld computer having moveable segments to affect a size of the handheld .

5   computer. In the following description, for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be apparent, however, that the present invention may be practiced without these specific details. In other

10   instances, well-known structures and devices are shown in block diagram form in order to avoid unnecessarily obscuring the present invention.

A. Overview

15

In an embodiment, a handheld computer includes multiple segments that are moveably connected and adjustable to affect an overall size of the handheld computer.

20   In one embodiment, a first segment is moveably connected to a second segment. The first segment includes a contact-sensitive display. The second segment includes an input mechanism. The first segment and second segment can be

moved between a contracted position and an extended position. In the contracted position, the second segment is overlaid relative to the first segment so that a portion of the display assembly is not accessible. In the extended position,

5   the second segment is moved away from the display assembly so that all of the display assembly is accessible to a user of the handheld computer.

     In another embodiment, a second segment is slideably

10   coupled to the first segment. The second segment can be positioned relative to the first segment to overlay and reduce an area of the contact-sensitive display assembly.

     Moveable refers to movement in one or more directions,

15   including rotations, and combinations of motions. Slideable means movement primarily in one direction.

     A display surface is accessible if the surface can be contacted by the user. The display surface does not have to

20   be contact-sensitive to be accessible. The term accessible refers only to a physical relationship between the display and other surfaces of the handheld computer. If the display surface is accessible, then that display surface is not being

shielded by another component or surface of the handheld

computer.

Among other advantages, embodiments of the invention

5   allow for a handheld computer to vary the overall length of

the handheld computer by adjusting the position of the

segments relative to one another. A user can maintain the

handheld computer in a shortened or contracted state if the

user does not need to use certain features that can be

10   covered by the segments in the contracted position. For

example, portions of the display dedicated to or used

primarily for character entry may be covered by the

contracted segments of the handheld computer if the user does

not need to use the character entry feature of the handheld

15   computer. This allows the user to extend the handheld

computer for limited instances when character entry is

desired. Therefore, minimization of the size of the handheld

computer is not as constrained by character entry features or

input mechanisms.

20

Another advantage is that buttons or other mechanical

input mechanisms can be more centrally disposed on the

handheld computer. This allows the user to operate the device

with one hand, with a thumb or extending to manipulate the buttons. In this configuration, the weight of the handheld computer is more evenly distributed to lessen the strain on the user's hands and thumbs.

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B. Configurations for Handheld Computer With Moveable Segments

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FIG. 1 is a front view of a handheld computer 100, under an embodiment of the invention. The handheld computer 100 includes a first segment 110 moveably coupled to a second segment 120. In FIG. 1, second segment 120 is fully extended in relation to first segment 110.

15
The first segment 110 and/or the second segment 120 may be moved along an axis to affect a size of the handheld computer. The movement by the first segment 110 and/or the second segment 120 maybe linear. In one embodiment, one segment slides relative to another segment to affect the size

20
of handheld computer 100.

A front surface 112 of first segment 110 provides access to a contact-sensitive display assembly 125. The display

assembly 125 may include an immediate character recognition region 128, and an output region 126. A front panel 122 of second segment 120 provides a plurality of actuatable mechanisms.

5   The handheld computer 100 may be referenced to a top 102 and a bottom 104, and a pair of lateral sides 105. In the extended position, a top edge 123 of second segment 120 is positioned proximally to a bottom edge 113 of first segment

10   110. A length L of handheld computer 100 is defined by a distance between top 102 and bottom 104. A width W of handheld computer 100 is defined by a distance between lateral sides 105, 105.

15   Embodiments of the invention provide for the length of handheld computer 100 to be variable. In one embodiment, second segment 120 is moveable to position bottom 104 closer or farther away from top 102 on first segment 110.

20   The first segment 110 includes a reduced section 118. The reduced section 118 is formed by regions of first segment 110 that have a reduced peripheral thickness. The overall peripheral thickness of reduced section 118 enables second

segment 120 to move over first segment 110, as shown by FIG. 2. The reduced section 118 may be located on first segment 110 adjacent to second segment 120. In one configuration, reduced section 118 include recesses formed into front

5   surface of first segment 110, between each lateral side 105 and display assembly 125. The reduced section 118 may include one or more recesses that extend peripherally around first segment 110.

10   The display assembly 125 may be formed by a combination of a digitizer pad and screen. The screen and digitizer may be overlaid on all or portions of each other. In one implementation, the immediate character recognition region 128 may be formed by the digitizer pad, without the screen.

15   Logic may be included with handheld computer 100 to recognize characters entered onto the digitizer pad through contact by a stylus type device. This configuration for display assembly 125 may correspond to a GRAFFITI handwriting area provided on handheld computers operating a PALM OS. In another

20   implementation, immediate character recognition region 128 may be formed with the digitizer pad and digitizer completely overlaid with each other. Logic may be implemented to recognize characters entered onto the screen and digitizer

combination. This configuration may correspond to a jot

recognition area of a handheld computer operating a POCKET PC

operating system.

5   The actuatable mechanisms provided on front panel 122 of

second segment 120 include a combination of actuation

mechanisms 132, as well as a multi-directional component 134.

The actuation mechanisms 132 are mechanisms that have one of

two states actuated and not actuated. The multi-directional

10   component 134 has multiple states-one state for each

direction it can be actuated in, and a non-actuated state.

The multi-directional component 134 may also have a center

actuation state, corresponding to being centrally contacted

or pressed straight down. The actuatable mechanisms 132

15   and/or multi-directional component 134 may be formed from

buttons, contact-sensitive surfaces, or other mechanical

switches.

In one embodiment, actuatable mechanisms 132 comprise a

20   thin rigid membrane that is disposed over the buttons to

create actuation surfaces. An example such an embodiment is

shown in FIG. 8.

The immediate character recognition region 128 uses a

look-up table or other similar data structure to match a

shape of a contact stroke with an input. In a typical use,

immediate character recognition region 128 is used for

5   character entry, and actuatable mechanisms 132 and

multi-directional member 134 are used for selection of

displayed data.

FIG. 2 is a front view of handheld computer 100 in a

10   contracted position. In the contracted position, second

segment 120 is moved over the portion of first segment 110

corresponding to reduced sections 118. A top edge 123 of

second segment 120 is moved to be distal to bottom edge 113

(FIG. 1) of first segment 110. The top edge 123 moves a

15   distance of X from the extended position to the contracted

position. As a result, the overall length L of handheld

computer 100 is reduced by X when handheld computer 100 is in

the contracted position.

20   In one embodiment, distance X may correspond to a length

of immediate character recognition region 128. As a result,

front panel 122 of second segment 120 is positioned in front

of immediate character recognition region 128 when handheld

computer 100 is in the contracted state. The immediate

character recognition region 128 is no longer accessible to a

user when second segment 120 is moved into the contracted

position.

5

According to one configuration, handheld computer 100 is

in a character entry mode in the extended position. In the

character entry mode, handheld computer uses a feature such

as the display to receive characters. Other embodiments may

10 provide for a mechanical keyboard that can be used to enter

characters in the character entry mode. In the contracted

position, handheld computer 100 may be in a selection mode.

The actuatable mechanisms 132 and multi-directional member

134 may be used to make selections based on information

15 provided on the screen of display assembly 125. For example,

menu items, data entries, or applications may be selected

using actuatable mechanisms 132. The actuatable mechanisms

may cover or otherwise overlap the character entry feature

when handheld computer 100 is in the selection mode.

20

FIG. 3 is a back view of handheld computer 100 in the

extended position. A back panel 162 of second segment 120 is

disposed over a back surface 114 of first segment 110. A pair

of coupling features 116 are formed into back panel 162. The

coupling features 116 are for detachably coupling to

accessory devices, such as modems. The reduced section 118 is

also disposed on back surface 114 of first segment 110. In

5   the extended position, back panel 162 of second segment 120

can be moved into the extended position to expose reduced

section 118.

A connector 130 is provided on a bottom surface 135. In

10   one configuration, connector 130 is a feature of second

segment 120, and bottom surface 135 is a region on second

segment 120. The connector 130 may be used to couple to an

accessory device, such as a cradle for a docking port. The

connector 130 may also be used to couple to an accessory

15   device that is secured to the back of handheld computer 100

using coupling features 116.

FIG. 4 is a back view of handheld computer 100 in the

contracted position. The second segment 120 is moved over

20   reduced sections 118, shrinking the length of handheld

computer 100. The bottom surface 135 and connector 130 are

not affected when handheld computer 100 is in the contracted

position.

FIG. 5 is a side view of handheld computer 100 in the extended position. The lateral side 105 may include one or more accessory slots 107. The accessory slot 107 is formed as a partially-enclosed opening that extends lengthwise from near top 102 towards bottom 104. The accessory slot 107 is shown engaged with a stylus 140. In the extended position, accessory slot 107 is larger than stylus 140, so that rail gap 109 is formed between the top of the rail and stylus 140.

A lengthwise opening in accessory slot 107 permits for extensions to connect onto the stylus 140 or other stylus shaped member contained with accessory slot 107. The extensions can extend out of accessory slot 107 to form another type of accessory device. For example, a spine may be substituted for stylus 140. A cover portion may be attached to the spine using the lengthwise opening in accessory slot 107.

FIG. 6 is a cross-sectional view of FIG. 5, cut along lines A-A. The accessory slot 107 includes a lengthwise opening 111 that is formed along a majority of the rail's length. The opening 111 permits for devices that engage

accessory slot 107 to include sections that extend out of the accessory slot 107.

FIG. 7 is a side view of handheld computer 100 in the
5   contracted position. The accessory slot 107 may be reduced in length, but still long enough to accommodate stylus 140.

The accessory slot 107 may be a housing feature on one or both of the other lateral side 105. In an embodiment, each
10   lateral side 105 includes accessory slot 107. One of the rails 107 may be used to hold stylus 140. Another accessory slot 107 may be used to hold the spine of another accessory device.

15   C. Construction of Moveable Segments

FIG. 8 is an exploded isometric view of handheld computer 100, showing construction of first segment 110. The first segment 110 includes a front shell 142 and a back shell 144.
20   The display assembly 125 is positioned between the front shell 142 and the back shell 144. A printed circuit board 152 is positioned underneath display assembly 125. The midframe

145 forms a peripheral strip of the housing for handheld

computer 100, between front shell 142 and back shell 144.

In one construction, display assembly 125 is located

5   within a space provided by front shell 142. The front shell

142 includes an opening 138 where display assembly 125 is

accessible to a user for viewing or for contact. The reduced

section 118 is formed on a bottom portion of front shell 142

and back shell 144. The reduced section 118 has dimensions in

10   the vertical direction Z, and in the lateral direction Y,

that are reduced in comparison to the remainder of front

shell 142 and back shell 144.

The midframe 145 includes an opening 148 to retain PCB

15   152. The midframe 145 may be formed by three of four

orthogonally aligned legs that form a perimeter portion of

handheld computer 100. Each lateral side 105 of handheld

computer 100 includes a surface comprising portions of front

shell 142, back shell 144, and midframe 145. As described in

20   greater detail with FIGS. 11 and 12, midframe 145 is provided

one or more rails 159 for receiving a connecting element of

second segment 120. The midframe 145 may extend to both

lateral sides 105 of handheld computer 100, and each lateral

side may have rail 159 formed therein.

The display assembly 125 may be formed from a digitizer

5   combined with a screen. The immediate character recognition

region 128 may be located towards the bottom of first segment

110.

As described, back shell 144 includes portions of reduced

10   sections 118, that mirror the shape and location of the

portion of reduced section in front shell 142. When front

shell 142 and back shell 144 are combined, the resulting

reduced section 118 form a region that allows for second

segment 120 to slide over first segment 110.

15

In an embodiment, midframe 145 is formed from a moldable

material such as plastic or rubber. The first segment 110 and

second segment 120 may be plated with metal or other hard

materials.

20

FIG. 9 is an isometric view of second segment 120 for

handheld computer 100. The second segment 120 includes a

housing 164 combined with back plate 162. The back plate 162

slides along the back surface of handheld computer 100. The

housing 164 has dimensions in the vertical direction Z, and

in the lateral direction Y, that match those dimensions of

first segment 110. In the contracted position, top edge 123

5   of second segment 120 is abutted against bottom edge 113 of

first segment 110,. The dimensions of housing 164 enable

second segment 120 to be combined with first segment 110 to

give the appearance that one housing contains components of

both first segment 110 and second segment 120.

10   .

In an embodiment, front panel 122 of second segment 120

is mounted on top of an interior panel 126. The interior

panel 126 includes pressable mechanical actuators, including

actuators 133 for input mechanisms 132, and actuators 137 for

15   multi-directional member 134. The front panel 122 is a thin,

flexible membrane that can be flexed in regions corresponding

to the position of actuators 133 and 137. For example, front

panel 122 maybe a thin sheet of metal that can be pressed

inwards at select locations corresponding to where actuators

20   133, 137 reside on interior panel. Markings may be provided

on front panel 122 to indicate location of the actuators 133,

137. An opening 127 may house a joystick, pad, cross-member

or other device for multi-directional member 134. The device

housed within opening 127 may be used to selectively contact one or more of the actuators 137.

A flex cable 135 may be extended from within housing 164. The flex cable 135 may connect to the actuators 133, 137 to extend communications from those actuators to the PCB 152. The flex cable 135 is provided on a front surface of back plate 162. The back plate 162 is moveable a distance X along the back surface 114 of first segment 110. The coupling features 116 may be shaped as openings on back plate 162, to enable attachment of mechanical couplings extended from an accessory device.

The second segment 120 includes a bottom surface 108 for handheld computer 100. The bottom surface 108 provides access to connector 130. Access to connector 130 is not altered as second segment 120 is moved between the contracted position and the extended position. While bottom surface 108 is shown to be relatively flat and orthogonal to front panel 122 embodiments of the invention provide for bottom surface 108 to be contoured into the shape of the back plate 162 and front panel 122. Furthermore, connector 130 maybe disposed along both a bottom and back plane.

The back plate 162 includes lateral sides 165, 165. A
distance W1 between lateral sides 165 is less than the
distance W between lateral sides 105 of first segment 110

5   (See FIG. 1). As will be described with FIG. 13, lateral
sides 165 may be shaped to be substantially liner in order to
engage corresponding ridges 117, 117 on the back surface 114
of first segment 110. A connecting member 131 is positioned
towards the top of back plate 162. As will be described in

10 FIG. 14, the connecting member 131 is configured to engage
the ridges 117 on the back surface 114 of first segment 110.

FIG. 10 is a simplified side view of first segment 110
and second segment 120 in the extended position. The reduced

15 section 118 of first segment 110 is exposed. The back panel
of second segment 120 is provided adjacent back surface 114
of first segment 110, opposing the front surface 112.

In FIG. 11, back panel 162 is moved the distance X along

20 the bottom surface 114. The direction is unilateral, so that
back panel 162 is sliding along back surface 114. The second
segment 120 is moved over the reduced sections 118 of first
segment 110.

FIG. 12 is a side cross-sectional view of handheld computer 100, showing first segment 110 and second segment 120 configured with respect to display assembly 125. FIG. 11 is a partial view, showing only a thickness of handheld computer 100 corresponding to where display assembly 125 is housed.

In one embodiment, display assembly 125 comprises a digitizer 172 combined with a screen 174. This construction provides for a contact-sensitive display assembly 125. Input may be entered onto display assembly 125 through contact with digitizer 172.

In an embodiment, immediate character recognition region 128 may be formed by extending digitizer 172 beyond screen 174 in the lengthwise direction. The result is that input can be received in immediate character recognition region 128, but output cannot be displayed.

Other embodiments that use immediate character recognition region 128 may combine digitizer 172 and screen 174. The immediate character recognition region 128 may be a

selectable feature that appears in a designated regions of the viewable display. In most conventions, immediate character recognition region 128 appears towards the bottom of the viewable display. This position also corresponds

5   towards a bottom of first segment 110.

The immediate character recognition region 128 of display assembly 125 may correspond to the location of reduced section 118 of first segment 110. Therefore, when second

10 segment 120 is moved into the contracted position, second segment 120 is positioned over immediate character recognition region 128. The contracted position of handheld computer 100 may correspond to a selected mode where character entry is not possible. However, since input

15 mechanisms 132 (FIG. 1) and multi-directional member 134 (FIG. 1) are accessible, data may be selected and displayed when handheld computer 100 is in the contracted position.

20 D. Attachment of Moveable segments for Handheld Computer

FIG. 13 is a back isometric view of handheld computer 100, showing a first set of connecting mechanisms for

moveably connecting first segment 110 and second segment 120

together on the back side of handheld computer 100. In an

embodiment, second segment 120 is provided connecting members

131 on lateral sides 165 of back plate 162. Each connecting

5   member 131 connects to a rail formed by ridges 117 on back

surface 114 of handheld computer 100. In an embodiment,

connecting members 131 are not removable from ridges 117, but

can be slideably engaged with ridges 117 to move a distance X

corresponding to the contracted and extended positions.

10

The connecting members 131 may be biased and moveable

into lateral sides 165 of back plate 165. Engagement

apertures 119 and bottom engagement apertures 121 may be

provided along ridges 117. The engagement apertures 119

15   enable connecting members 131 to extend outward and lock

second segment 120 into position so as to not be moveable.

The connecting members 131 may be accessible from the back

panel 162 to release the lock and allow second segment 120 to

move relative to first segment 110. The top engagement

20   apertures 119 may be locked into by connecting members 131 to

place handheld computer 100 in the contracted position. The

bottom engagement apertures 121 may be locked into by

connecting members 131 to place handheld computer 100 in the

extended position. The back plate 162 may be precluded from moving connecting members 131 beyond top and bottom engagement apertures 119, 121.

5   FIG. 14 is a front isometric view of handheld computer 100, showing a second set of connecting mechanisms for moveably connecting first segment 110 and second segment 120 together on the front side of handheld computer 100. The second set of connecting mechanisms shown in FIG. 13 may be

10 used jointly with connecting mechanisms shown in FIG. 12. Alternatively, the first or second set of connecting mechanisms may be used alone. Other moveable connecting schemes for moveably joining first segment 110 and second segment 120 are also contemplated by this application.

15

The housing 164 of second segment 120 includes an interior 167. The interior 167 has connecting structures 169. The connecting structures 169 maybe elongate extensions of housing 164, extending at least partially lengthwise within

20 housing 164.

In addition, lateral sides 105 of first segment 110 include rails 159 that are configured to receive connecting

structures 169. The rails 159 maybe formed into the midframe

145 of first segment 110. Structures within rails 159 and/or

on connecting members 169 may facilitate second segment 120

being retained in the contracted or extended position. For

5   example, rails 159 may be provided with internal divots or

dimples that require an additional sliding force to enable

connecting members 169 to slide past their engagement. The

connecting members 169 may include extensions that engage the

divots or dimples to further facilitate a retaining

10   engagement. The extensions may be biased. The retaining

engagements may be positioned along the length of rails 159

and connecting members 169 corresponding to the contracted

and extended positions of handheld computer 100. While the

retaining engagements keep second segment 120 in a fixed

15   relationship relative to first segment 110, the retaining

engagements can be overcome to enable second segment 120 to

slide back and forth. However, an embodiment of the invention

provides that second segment 120 cannot be detached from

first segment 110.

20

    FIG. 15 is a cross-sectional view taken along lines B-B

of FIG. 14, illustrating rails 159 of first segment 110. The

rails 159 are provided on midframe 145, between front shell

142 and back shell 144. The rails 159 may include an opening

181 positioned laterally to enable engagement by connecting

members 169 of second segment 120. The rails may be T-shaped

to enable connecting members 169 to engage rails ¦59, while

5   allotting for an exterior shell of second segment 120.

FIG. 16 is a cross-sectional view taken along lines C-C

of FIG. 14, illustrating connecting members 169 of second

segment 120 configured for engaging rails 159 of first

10   segment 110. The connecting members 159 extend inward from a

shell 129 of housing 164 on second segment 120. The

connecting members 169 are shaped for rails 159 of first

segment 110. To this end, connecting members 169 may include

a bulbous end 167, or other configuration to enable a

15   non-detachable and slideable connection with first segment

11.

E. Hardware Diagram

20   FIG. 17 is a block diagram for a handheld computer 200

formed from moveably coupled segments, under an embodiment of

the invention. One of the segments 110, 120 in handheld

computer 100 carries a majority of the components for

performing the core functions of the handheld computer. In an

embodiment, first segment 110 carrying the display assembly

125 for handheld computer 100 is assumed to have the majority

of components.

5

In an embodiment, handheld computer includes a processor

240 coupled to a first memory 244 (non-volatile) and a second

memory 246 (volatile). The processor 240 is coupled to a

display driver 222. The processor 240 combines with display

10   driver 222 to process and signal data for presentation on a

display assembly 220. The display assembly 520 includes

screen and digitizer.

An analog-digital (AD) converter 232 is coupled to

15   processor 240. One or more channels from A/D converter 232

maybe used to convert analog input provided by the digitizer,

or by another analog input mechanism.

The handheld computer 100 may include one or more

20   expansion ports for coupling to accessory devices, such as

cradles, modems, memory units, re-chargers and other devices.

Examples of expansion ports include serial ports, Universal

serial Bus (USB) ports, CompactFlash slots and infra-red

ports. In an embodiment shown, a first expansion port 202
enables one or more types of expansion modules to be
connected to processor 240. The handheld computer 100 may
also include a second expansion port 204 to couple to another
5   accessory device. Each port 202, 204 is shown to be coupled
to processor 240, although the components that receive a
signal from one of the expansion ports 202, 204 are
determined by the type of accessory device selected.

10   The accessory device that may be coupled to expansion
port 202 may be identified by primary functions of their
internal components. Each accessory device may include one or
more of the following set of components: a radio-frequency
transmitter and/or receiver 252, a processor 254, an input
15   mechanism 256, additional memory 258, a battery 260, or
another A/D converter 262. The same components may be used
with expansion modules to second expansion port 204.

F. Alternative Embodiments

20

Embodiments described herein have provided for first
segment 110 to include a display assembly, and second segment
120 to include input mechanisms. The relationship between the

second segment 120 and first segment 110 has included

configurations where second segment 120 has been positioned

to overlay first segment 110. Other embodiments, however, may

provide for the relationship between first segment 110 and

5   second segment 120 to be reversed. For example, first segment

110 may be moved so that a display surface over lays the

buttons. The second segment 120 may provide for the display

assembly while first segment 110 provides for input

mechanisms. Other examples and configurations are also

10   contemplated by embodiments of the invention.

While embodiments described above provide for housing

segments to reduce a length of handheld computer 100, other

embodiments may provide for a similar configuration to be

15   used for a width of handheld computer 100, where lateral

sides 105, 105 can be moved closer to or further away from

each other by first segment 110 and second segment 120.

Embodiments described above provide certain

20   configurations for rails and connecting members. While

embodiments described provide for first segment 110 to

include rails, and second segment 120 to be configured to

engage the rails, other embodiments may reverse the

relationship. The second segment 120 may include rails that
are engaged by connecting members, ridges or other structures
·of first segment 110.

5   G. INTERACTIVE DISPLAY

    A handheld computer as described above may further
include a sensing device that produces a signal that is
dependent upon the relative position of the first segment and
10 the segment. This signal may be used by the handheld computer
to configure the visual output of the display.

    FIG. 18 shows a handheld computer 1800 similar to that
shown in FIG. 1. The processor module 1801 is similar to
15 first segment 110 of FIG. 1, and keypad slider 1802 is
similar to the second segment 120 of FIG. 1. The keypad
slider 1802 is an example of a sliding display cover having a
key pad 1803 for user input. The processor module includes a
display 1804. The display 1804 is a preferably a touch panel
20 display; however, it may be a conventional display such as a
liquid crystal display (LCD) or it may be a touch panel
display capable of accepting input from user.

The processor module 1801 and keypad slider 1802 include a sensing device to produce a signal containing information regarding the relative position of the processor module 1801 and the keypad slider 1802. The sensing device may be a

5   contact sensor such as a variable resistance potentiometer, or it may be a non-contact sensing device using an optical or magnetic transducer to detect the relative position.

The signal coupling between the keypad slider 1802 and

10   the processor module 1801 may be achieved by sliding contacts, a flexible ribbon connector. Alternatively, the keypad slider 1802 and the processor module 1801 may be optically coupled (e.g., a light emitting diode and detector pair).

15   For handheld computers having a touch panel display, the sensing device may be provided by the touch panel display 1804 and a physical feature incorporated in the keypad slider 1802. The physical feature may simply be the edge of the keypad slider, or it may be one or more protrusions or

20   sensing features on or near the edge of the keypad slider 1802 that is adjacent to the display 1804. When the display 1804 is a near field imaging (NFI) or capacitive display, sensing can be done with very light contact and essentially

zero displacement at the display surface. For protrusions

that establish contact with the display surface, the

preferable location is at the edges of the display. For touch

panel displays that require a degree of displacement at the

5   input surface, a roller may be used to provide a contact with

minimal wear and friction.

When the touch panel display 1804 is used as the sensing

device, the information concerning the geometric relationship

10   between the sensing features, the edge of the keypad slider

1802 and the touch panel display coordinates is available to

the processor. Likewise, the signal from any other type of

sensing device would be correlated with the relative position

of the keypad slider 1802 with respect to the processor

15   module 1801.

In an embodiment of the invention, the processor of the

handheld device 1800 uses the available position information

to arrange displayed visual objects so that they are viewable

20   in response to the relative position of the processor module

1801 with respect to the keypad slider 1802. A visual object

1805 is shown on the lower portion of the display 1804 of

FIG. 18. The handheld computer 1800 is in a fully extended

configuration and the edge of the keypad slider 1802 is aligned with the edge of the visual object 1805.

In FIG. 19, the handheld device of FIG. 18 is shown in a
5   partially closed position. The location of the visual object 1805 has been changed in order to maintain visibility. The visual object 1805 may be made up of one or more icons associated with the touch panel display 1804, that serve to label areas of the touch screen that are associated with
10 actions performed by the processor module 1801.

Alternatively, the visual object 1805 may be a collection of icons associated with keys on the adjacent keypad slider 1802. The sensing device signal may be used to
15 maintain proximity between icons displayed on the display 1804 and the edge of the keypad slider 1802.

In response to the shrinking of the visible area of the display 1804, the processor may scale the size of the overall
20 display image, or maintain the size of the image and scroll it, or both.

In another embodiment of the invention, the information from the sensing device is used to reference a collection of symbols presented on a display of a handheld computer. FIG. 20 shows a handheld computer 2000 having a processor module

5   2001, a keypad slider 2002, a select button 2003, and a display 2004.

The display 2004 shows a macro command list 2005. A macro command is a string of one or symbols arranged in a

10   line approximately parallel to the edge of the keypad slider 2002. For example, a macro command may be an ASCII character string that refers to an executable command or series of commands. For example, the character string may be an email address or telephone number that may be selected for sending

15   an email or initiating a telephone call. Once selected, the macro command may be executed by appropriate input such as pressing the select button 2003.

FIG. 21 shows the handheld computer of FIG. 20 with the

20   macro command "macro command 1" 2100 selected. A desired macro command is selected by adjusting the position of the keypad slider 2002 with respect to the processor module 2001 so that the edge of the keypad slider 2002 underlines the

desired macro command. Once selected, a macro command may be executed by pressing the select button 2003. The set of instructions used by the processor to select a macro command is referred to as a line selection driver.

5

The assignment of an instruction or series of instructions to a character string has a particular advantage over assignment to a key or combination of keys. A character string may serve as an effective mnemonic device. For

10 example, associating a telephone number or email address with a person's name as a macro command is more natural than associating the person's telephone number or email address with a number.

15 FIG. 22 shows a handheld computer integrated with a wireless telephone. A processor module 2201 having a wireless transceiver is slideably coupled to a keypad slider 2202. The processor module 2201 has an integrated speaker (earpiece) 2205, and the keypad slider 2202 includes an integrated

20 microphone 2204. The coupling of the processor module 2201 and keypad slider 2202 may include a detent mechanism to provide for repeatable and stable sliding configuration of the keypad slider 2202 and the processor module 2201.

Alternatively, the microphone 2204 shown on the front

side of the keypad slider 2202 may be located on the back of

the keypad slider 2202, and the speaker 2205 of the processor

5   module 2201 may be located on the back side of the processor

module 2201.

Dialing of the telephone may be accomplished by using

the keypad 2203, or using the previously described macro

10   command selection technique. In the fully compact

configuration shown in FIG. 21, a portion of the display

remains visible, enabling dialing and wireless reception of

text messages while maintaining the most compact

configuration. Further details regarding the types of

15   functionality and construction that may be embodied in the

integrated device are disclosed in the U.S. Patent

Application of Nguyen and Lam, titled "Integrated Handheld

Data Processing Device Having a Sliding Form Factor", filed

November 30, 2001, which is wholly incorporated by reference

20   herein.

The foregoing descriptions of specific embodiments of

the present invention have been presented for purposes of

illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. The embodiments

5   were chosen and described in order to best explain the principles of the invention and its practical application, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications are suited to the particular use contemplated. It is intended

10 that the scope of the invention be defined by the Claims appended hereto and their equivalents.